

LIFE HISTORY NOTES AND NEW FOOD PLANT RECORDS FOR
GRAPHIUM MACFARLANEI MACFARLANEI (BUTLER, 1877)
 (LEPIDOPTERA: PAPILIONIDAE, PAPILIONINAE)

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Abstract

All life history stages of the Green Triangle butterfly, *Graphium macfarlanei macfarlanei* (Butler), are described and illustrated from observations made in Cairns, Queensland. Development times for each stage are given. Use of the cultivated custard apple *Annona reticulata* as a food plant is confirmed and four new food plants (three native and one introduced) are recorded, all Annonaceae. Use of the introduced Indian Mast Tree, *Polyalthia longifolia pendula*, as a larval host has increased abundance of the butterfly in the Cairns region.

Introduction

The Green Triangle, *Graphium macfarlanei macfarlanei* (Butler, 1877) (Figs 1-2), is part of the papilionid tribe Leptocircini (= Graphiini), which also includes the genera *Protographium* Munroe and *Graphium* Scopoli (Orr and Kitching 2010). Within Australian limits, *G. macfarlanei* ranges from the Torres Strait Islands south to Weipa and the McIlwraith Range and from Cooktown to Ingham (Braby 2000, Dunn and Dunn 2006). There is an unconfirmed southern vagrancy record from coastal woodlands near Bowen (Dunn 2008). Braby (2004) listed its status as 'common but local on Cape York Peninsula; rare in the wet tropics'.



Figs 1-2. Adults of *Graphium macfarlanei* from Cairns Queensland; upperside left, underside right: (1) male; (2) female.

Prior to this paper, the larval food plants [all Annonaceae] were listed by D'Abrera (1971) as *Annona muricata* (Sour Sop) and *A. squamosa* (Sugar

Apple). Common and Waterhouse (1972) added *A. reticulata* (Custard Apple), while Braby (2000) added *Rollinia deliciosa* (Brazilian Custard Apple), the native *Desmos* sp. and possibly *Xylopia* (probably based on the citation in Parsons 1998) to the list, but considered the record of *A. reticulata* as 'unconfirmed'. Orr and Kitching (2010) excluded the 'unconfirmed' *A. reticulata* record from their list of food plants for *G. macfarlanei*.

Braby (2000) noted that little was known about the immature stages and gave a brief description of larva and pupa based on photographs taken by R.W. Guard. The egg has not been recorded previously.

The author began sighting adults of this species on a regular basis after moving to Greenforest, 10 km west of Kuranda, northern Queensland, in 1999. Here, adult males would patrol high above canopy clearings during most months of the year, with the females tending to fly along the edges of the rainforest. However, it was not until moving to suburban Cairns some years later that the author began breeding this species and was able to substantially add to published details of its life history and food plants.

Observations

Immature stages and behaviour

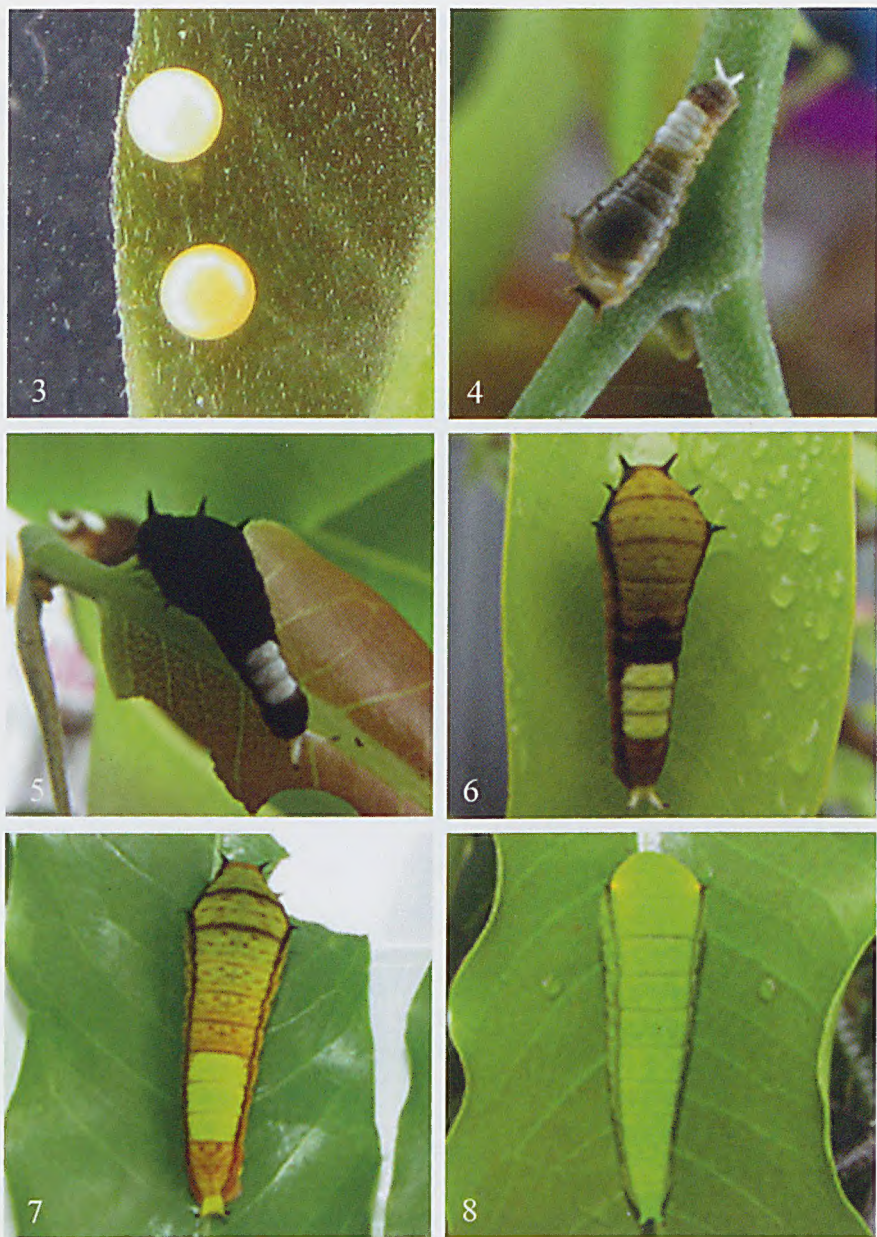
Egg (Fig. 3): Pale yellow (almost white) when laid, later changing to a dark yellow. Spherical and smooth; under 10 x magnification 1.4 mm in diameter. Eggs are laid singly on the larval food plant, usually on the upperside or edge of young foliage or on an adjacent more mature leaf. However, a returning female will lay more eggs adjacent to existing eggs.

Larva: 1st instar (Fig. 4) larvae are caramel coloured with a white patch on the upperside of the lower abdomen. The head is also white, which fades to brown after the first few days. The thorax has six thoracic horns and the abdomen has a series of fine hairs, with a characteristic white forked tail just above the anal plate. First instar larvae usually rest on the upperside of the food plant's juvenile growth and reach 3 mm in length.

2nd instar (Fig. 5): These are a darker brown, with more contrast between the brown and the white patch on the abdomen. The fine hairs are gone, leaving just the six thoracic horns and forked tail. They usually rest on the upperside of the more mature leaves and reach 9 mm in length.

3rd instar (Fig. 6): These develop a green colouration to the thorax and the patch on the abdomen. However, colour variation can range from dark brown to orange or lime green, depending on which food plant they are feeding. Larvae feeding on *Polyalthia* sp. are more likely to have a mottled greenish-brown appearance, while larvae on *Annona muricata* are likely to be lime green. Third instar larvae reach approximately 17 mm in length.

4th instar (Fig. 7): These develop the green colouration further, with the light patch on the abdomen becoming less conspicuous. The thoracic horns



Figs 3-8. *Graphium macfarlanei*: (3) eggs on leaf of *Polyalthia longifolia*; (4) 1st instar larva; (5) 2nd instar larva; (6) 3rd instar larva on leaf of *Annona muricata*; (7) 4th instar larva; (8) final instar larva.

become less pronounced as the larva grows. Larval colours are still highly variable in this instar, which reaches around 27 mm in length.

Final instar (Fig. 8): These tend to be more uniform in colour. However, they can vary from lime green to a yellowish brown (Figs 13-14). The white patch on the abdomen is usually absent. The short thoracic horns are usually black, but can have a red or pink base around them (e.g. Fig. 14). They reach 46 mm in length. Freshly moulted larvae consume the sloughed skin and discard the head capsule.

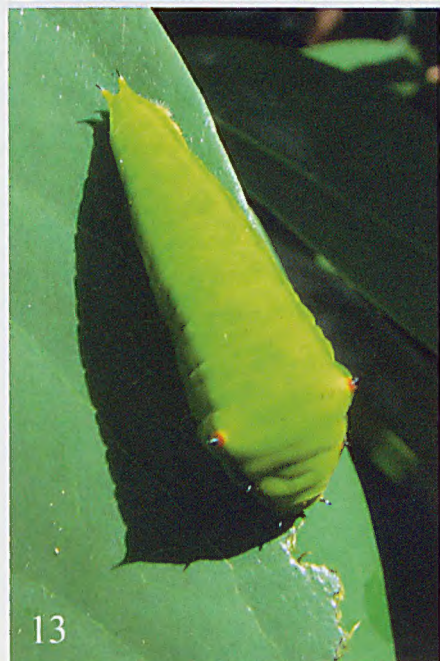
Pupa (Figs 9-10): This is well described in Braby (2000) and is around 36 mm in total length.



Figs 9-10. Pupa of *Graphium macfarlanei*: (9) lateral view; (10) dorsal view.

Parasites: Many eggs are parasitised by wasps before they hatch. Larvae and pupae can be susceptible to parasitism by tachinid flies at certain times of the year, but parasitism appears to be more prevalent during the wet season.

Comments: Larvae and pupae of *G. m. macfarlanei* from Australia show a superficial resemblance to those of *G. m. seminigra* Butler from New Britain (see D'Abrera 1971). Larvae are variable in colour (Figs 11-14) and pupate on the underside of mature leaves of the larval food plant, where they can be difficult to detect. Pupal colouration can vary a little, depending on the food plant tree. Pre-pupal larvae may leave the host tree to pupate if given the opportunity. Pupae may be found on nearby trees or vines provided that they are physically connected to the host (such as by vines). Larvae have not been observed descending to the ground to leave the host tree.



Figs 11-14. *Graphium macfarlanei*; larval colour variation: (11-12) 3rd-4th instars; (13-14) final instars.

Duration of early stages

The duration of the immature stages in Cairns between February and March was as in Table 1, based on a single specimen followed right through from egg to adult. Pupal duration ranged from 12 to 16 days (Average 14.4, $n = 8$), based on a series of pupae reared during March and April.

Table 1. Duration of larval and pupal stages of a specimen of *Graphium macfarlanei*.

Stage	Start	End	Days	length (mm)	Larval head capsule width (mm)
Egg	8.ii.2013	10.ii.2013	3	1.4	-
1 st instar	11.ii.2013	13.ii.2013	3	3	0.5
2 nd instar	14.ii.2013	15.ii.2013	2	9	1.0
3 rd instar	16.ii.2013	17.ii.2013	2	17	1.5
4 th instar	18.ii.2013	19.ii.2013	2	27	3.0
5 th instar	20.ii.2013	24.ii.2013	5	46	4.2
Pupa	25.ii.2013	8.iii.2013	12	36	
TOTAL			29		

Larval growth rate

Daily length measurements were taken during the larval development for a single specimen. These figures were plotted and produced the following graph (Fig. 15), which shows the acceleration in growth in the fourth and fifth instars. The larva releases some of its fluid in the final instar just before pupation and contracts in size.

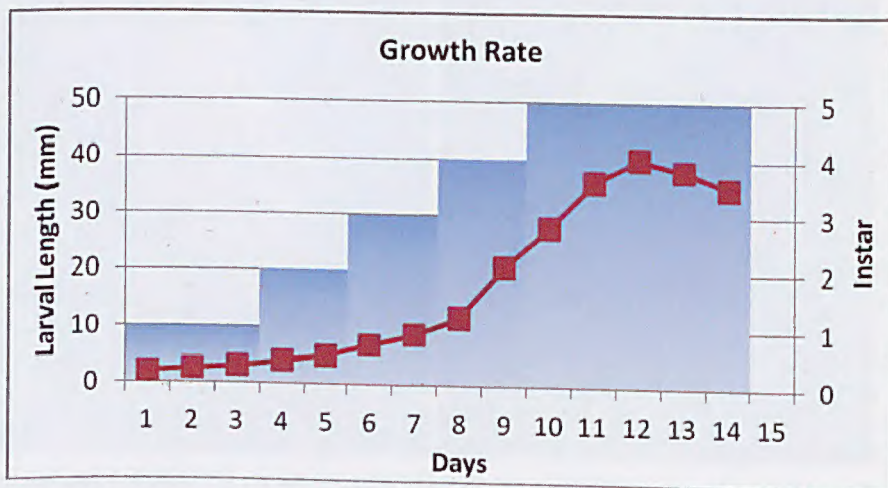


Fig. 15. Larval growth rate.

The larva was reared on a series of small potted plants of *Annona muricata*, changed over regularly to ensure that fresh, soft growth was always available to the larva to allow it to fully develop.

New food plant records

1. Indian Mast Tree – *Polyalthia longifolia pendula* (Sonn.) (Annonaceae).

The Indian Mast Tree (Figs 16-17) is a fast growing, lofty evergreen tree native to India. It exhibits symmetrical pyramidal growth with weeping branches and long, narrow lanceolate leaves with undulate margins. Fresh leaves are coppery brown and are soft and delicate to touch; as the leaves grow older the colour becomes a light green and, finally, a dark green.

The Indian Mast Tree is gaining popularity as an ornamental tree in landscaped gardens and can be found commonly around Cairns and other tropical northern Queensland centres. The author has many of them in his backyard, which are frequently visited by *G. macfarlanei* adults for oviposition. The author has reared many adults on this species of plant throughout the year. Adults prefer to oviposit on or adjacent to the juvenile coppery-brown leaves. Larvae prefer the juvenile growth.

2. Raspberry Jelly Tree – *Miliusa brahei* (F. Muell.) Jessup (Annonaceae).

Miliusa brahei is endemic to Australia, being widespread in Western Australia, Northern Territory, Cape York Peninsula, northeastern Queensland and southwards to coastal central Queensland. Altitudinal range is from near sea level to 250 m. It grows in monsoon forest and drier rainforest.

Two small trees of *M. brahei* were purchased from Yuruga Nursery, Walkamin in northern Queensland in June 2009. Over the past two years, adults of *G. macfarlanei* have occasionally oviposited on the new growth, with larvae being sleeved and reared to adults on this plant species.

3. Miliusa Tree – *Miliusa traceyi* Jessup (Annonaceae).

Miliusa traceyi occurs from Cape York to Lakeland Downs, as well as in the Northern Territory. It grows in gallery forest and the drier, more seasonal rainforests as an understorey tree with layered, drooping branches. The leaves are velvet-hairy underneath (Beasley 2009).

The use of *M. traceyi* as a host plant for *G. macfarlanei* has been known to entomologists for many years (D. A. Lane pers. comm.) but has remained unpublished. On a trip to Coen on Cape York Peninsula in January 2012, adults of *G. macfarlanei* were observed on the wing on the slopes and summit of Mt White. Larvae were found feeding on the juvenile growth of *M. traceyi*. David Lane has reared adults on this plant species.



Figs 16-18. Newly recorded larval food plants of *Graphium macfarlanei macfarlanei*: (16-17) *Polyalthia longifolia pendula*; (18) *Melodorum leichhardtii*.

4. Zig-zag vine - *Melodorum leichhardtii* (F.Muell.) Benth. (Annonaceae).

Melodorum leichhardtii (Fig. 18) is a scrambling climber that occurs in vine forests from Cape York to northeastern New South Wales (Beasley 2009).

While this plant species is a known host for *Graphium agamemnon* (L.), *Graphium eurypylus* (L.) and *Protographium leosthenes* (Doubleday), until now it has not been recorded as a host for *Graphium macfarlanei*.

In 2009, a juvenile plant was purchased from Yuruga Nursery and has been growing in the author's backyard in Cairns since then. On the 19 February 2013, a third instar larva of *G. macfarlanei* was noticed feeding on the fresh growth of this plant species. The larva was sleeved on the tree and pupated on 2 March 2013. The adult emerged on 14 March 2013.

This confirms *Melodorum leichhardtii* as a newly recorded host plant for *G. macfarlanei*.

Confirmed food plant record

Custard Apple - *Annona reticulata* Linn. (Annonaceae).

A single tree of *A. reticulata* was purchased from Limberlost Nursery in Cairns in January 2008. The plant contained eggs and early instar larvae of a *Graphium* sp., which were raised to adults and proved to be *G. macfarlanei*.

Over the last few years, wild adults of *G. macfarlanei* have regularly oviposited on the new growth of the *A. reticulata* tree, with many adults being raised on this plant species. Many larvae have also been collected from an *A. reticulata* tree at Kewarra Beach, north of Cairns. This confirms the record by Common and Waterhouse (1972) of *A. reticulata* as a food plant for *G. macfarlanei*.

Discussion

Of the several Annonaceae trees in the author's backyard, the favoured trees for oviposition of the Green Triangles are (in order of proliferation):

Annona muricata

Polyalthia longifolia

Annona reticulata

Miliusa brahei

Melodorum leichhardtii

However, the most significant factor influencing oviposition choice by adults seems to be the presence of fresh growth on which to lay eggs.

While the adults of *G. macfarlanei* are rarely seen in the wet tropics, the immature stages are considered to be seasonally abundant in Cairns (J. Olive pers. comm.).

An effective natural form of population control for *G. macfarlanei* (and many other species) appears to be the green tree ant, *Oecophylla smaragdina* (Fabricius), which naturally occurs in the majority of food plant trees that the author has examined. Winged females of *O. smaragdina* will land on the leaves of the food plant trees and establish a nest by creating a silken pad between two leaves. Here, the eggs are laid and a new nest established. This annual occurrence usually takes place in January.

Despite the predators, the author believes that as the planting of the Indian Mast Tree as an ornamental landscaping tree increases throughout the tropics, so too will the abundance of *G. macfarlanei*, with further range extensions of this species expected in the future.

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